



What's Operations Research? and Why Should We (Interagents) Care?

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Overview

- Operations Research (OR) defined
- History of OR / MORS support
- Potential interagency OR applications
- Summary

OR Defined

- Operations Research is:
 - Multi-disciplinary approach applying scientific method
 - Ask a Question
 - Do Background Research
 - Construct a Hypothesis
 - Test Your Hypothesis by Doing an Experiment
 - Analyze Your Data and Draw a Conclusion
 - Communicate Your Results
 - Inform decisions amongst alternatives
 - Maximize the utility of limited resources
- Operations Research is *not*:
 - A limited set of optimization tools/techniques
 - Multi-variate regression, linear regression,

It's all about decision support
If you have a decision to make, OR can help!

MORS Background

- Early Military Operations Research Symposium
 - First held at Corona Naval Ordinance Lab, CA; August 1957
 - Subject: Air Defense; 83 scientist attended
 - Ninth symposium (1962) held at Ft Monroe, VA as first National symposium
 - 11th Symposium ONR assumed organization responsibilities, hired contractor
- MORS incorporated under laws of Virginia as professional society in 1966
 - Sponsored by Navy, Army, Air Force, Marine Corps, Joint Staff, OSD
 - Department of Homeland Security joined Sponsor ranks in 2008
- Services
 - Annual symposium with special sessions and 33 working groups
 - 4-5 Special Meetings per year
 - PHALANX bulletin, MOR Journal, Heritage publications
 - Mentoring and networking within the OR profession

OR History

- Brief history of OR (from DSB Report on ISR applications)
 - World War I
 - Thomas Edison led anti-submarine warfare tactics study/development
 - World War II
 - English: C2 of fighter aircraft and ground-based radar for homeland defense against Hitler's Luftwaffe
 - American: Submarine search against Germany U-boats
 - Cold War
 - SIOP study of blast, thermal, nuclear effects and mission-asset allocation
 - 1986 Goldwater-Nichols Act
 - Brought independent (vs. McNamara's PPBS) use of systems analysis to requirement process
 - Joint Direct Attack Munition (JDAM) requirements analysis
 - Glenn Kent led reqmt defn and acquisition trade space optimization following Desert Storm
 - Weather, launch and leave, reduced crew workforce and cost

Current OR Applications – MORS Meeting Foci

- 33 working/6 composite groups meet at MORS' annual symposium
 - Homeland and International Operations
 - C4ISR & Net-Centric Operations
 - Joint Warfare
 - Resources/Readiness/Training
 - Acquisition
 - Interdisciplinary Advances in OR
- Recent Special Meetings
 - Power and Energy
 - Maritime Domain Awareness and Counter Piracy
 - Risk-Informed Decision Making for HLS Resource Allocation
 - Strengthening the Next QDR Through Timely and Relevant Analysis
 - Understanding the Consequences of Catastrophic Events: Using Methods and Tools to Analyze and Manage Incidents

Sample MORSS Papers – Interagency Interest

- Selection of papers presented at 77th MORSS (June 2009)
 - Overcoming Gaps Created by a Loss of Satellite Coverage
 - Effects of Situational Awareness on the Outcome of a Pandemic Influenza
 - Social-Science Foundations of Analysis for Counter-Terrorism
 - Public Opinion + Cultural Model + Experts = Extraordinary Insight
 - Vancouver 2010: Defense Against the Asymmetric Air Threat
 - Intelligent Adversary Risk Analysis
 - Social Network Analysis for Homeland Defense and Civil Support
 - Applying Crime Mapping and Analysis Techniques to Forecast Insurgent Attacks in Iraq and Afghanistan
 - Analyzing the Effectiveness of Mine Rollers/Persistent Surveillance Towers to Counter the Improvised Explosive Device Threat in Al Anbar, Iraq
 - Analysis of the Civilian Population in Stability Operations

Industry Applications

- Agriculture
 - Planting, procurement, distribution
- Airlines
 - Revenue management and pricing, network planning, crew scheduling, maintenance planning, parts inventory and fuel management
- Health care
 - Design of medical informatics, emergency room scheduling, resource modeling
- Manufacturing
 - Optimize factory operations, warehouse optimization, supply chain optimization
- Transportation
 - Air traffic control, trucking, railroad logistics ; real-time dispatching and delivery truck routing; international freight scheduling and container pricing

OR Success Stories

http://www.orchampions.org/prove/success_stories.php

- Select industry
 - Agriculture
 - Auto/vehicle
 - Food
 - Government
 - Health care
 - Manufacturing
 - Mining
 - Package & freight delivery
 - Pharmaceuticals
 - Sports
 - Telecommunication
- Select function
 - Capital budgeting
 - Decision support systems
 - Finance
 - Inventory
 - Medical research
 - Resource management
- Select benefit
 - Optimize resources
 - Increase revenue
 - Improve customer service
 - Rescue troubled product
 - Save lives

OR Success Stories

- Achieving and Systematizing Operational Efficiency at the 2004 Olympics
 - Optimize construction planning, execution and event management
 - Focus on competition venues, transporting athletes and spectators, coordinating volunteers, and managing municipal operations
 - Savings: \$55 million in resource management; \$15 million planning and design process efficiencies
- Air New Zealand Masters the Art of Crew Scheduling
 - Improve scheduling tours of duty and rosters
 - Saved NZ\$15,655,000 per year while providing crew rosters that better respect crew members' preferences
 - *(How many frequent flies wish their airline would use OR???)*

OR Success Stories

- Identifying/Neutralizing Deadly Side Effects of Anticancer Drug, ALIMTA
 - Eli Lilly developed “antifolate” class, showed effectiveness on lung cancer
 - Life-threatening side effects halted development
 - Used multiple logistic regression to study “markers” that predict toxic reaction
 - Determined folic acid and B12 deficiencies
 - Result: Allowed FDA approval, providing lung cancer treatment
- Delivering Rapid Restoration Capacity for the AT&T Network
 - Needed plan for restoration capacity and rapid response to network failures
 - OR team developed amount/location of restoration capacity, min cost
 - Extended tool to re-optimize restored network

Summary

- OR is application of the scientific method to inform decisions
- Early applications were military operations focused
 - Lanchester equations of combat
 - Anti-submarine warfare
 - Air defense resource allocation
- General resource allocation/optimization
 - Federal Express optimizes day-to-day ops and strategic resource planning
- Interagency applications
 - Pandemic planning
 - Terrorist behavior modeling
 - Information sharing